Helioseismic and Magnetic Effects of Solar Flares from SOHO Observations

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A detection by SOHO/MDI of helioseismic acoustic waves on the photosphere in a form of ripples caused by a X-class solar flare, as well as magnetic field variations associated with the similar X-ray solar flare revived an interest to the problem of energy transport in these active events from the corona into deeper atmosphere down to the photosphere. The shock waves resulting from a hydrodynamic response of a flaring atmosphere to electron beam injection were assumed to be a source of the observed acoustic waves in the solar interior. However, a comparison of theoretical models with the observations shows that such shocks may not deliver the momentum required to provide the observed amplitude of these waves. Furthermore, a detection of the wave-like variations of magnetic field in the photosphere associated with X-class flares and, also, accompanied by CMEs and well pronounced Moreton waves raised further questions about a depth of maximum energy deposition in solar flares. These discrepancies along with a very close temporal corelation between the X-ray and helioseismic wave onset time lead to a search for other possible mechanisms being able to deliver the energy and momentum to the lower chromosphere and photosphere, in particular, by energetic particles. The future observations of acoustic or magnetic waves with the high-cadence SOHO/MDI Dopplergrams and magnetograms and theoretical advances in the particle kinetics and flaring atmosphere dynamics can resolve this puzzle.